REMARKS

Claims 1-27 are pending in the application. Claims 1,2, 4-6, 8-10, 13, 15-18, and 21-25 are rejected. Claims 3, 7, 11-12, 14, 19-20, and 26-27 are objected to.

In the Office Action, the Examiner rejected claims 1, 4-6 and 8 under 35 U.S.C. § 103(a) as being unpatentable over Heimdal et al. (U.S. Patent No. 6,776,759) in view of Criton et al. (U.S. Patent No. 6,637,221). Claim 2 was rejected under 35 U.S.C. § 103(a) as being unpatentable over Heimdal et al. in view of Criton et al., and further in view of the background section. Claims 9-10, 13, and 15-18 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Heimdal et al. in view of Criton et al., and further in view of Torp et al. (U.S. Patent No. 6,676,599). Claims 21-22 and 25 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Sano et al. (U.S. Patent No. 6,064,391) in view of Cline et al. (U.S. Patent No. 5,412,563). Claim 23 was rejected under 35 U.S.C. § 103(a) as being unpatentable over Sano et al. in view of Cline et al., and further in view of Schwartz (U.S. Patent No. 5,720,291). Claims 21 and 24 were rejected under 35 U.S.C. § 103(a) as unpatentable over Sano et al. in view of Cline et al. and Odell (U.S. Patent No. 5,268,877) or Ri et al. (U.S. Patent No. 5,615,679).

Claims 3, 7, 11-12, 14, 19-20 and 26-27 were objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form. Independent claim 14 was objected to as being dependent on a rejected base claim. Since claim 14 was originally filed as an independent claim, Applicants respectfully submit that claim 14 should have been allowed.

Claims 7, 13, 14, and 21 have been amended.

Applicants respectfully request reconsideration of the rejections of claims 1-2, 4-6, 8-10, 13, 15-18 and 21-25, including independent claims 1, 13, 15 and 21.

Independent claim 1 claims "determining a spatial gradient vector in an acoustic domain for at least one ultrasound data sample; and transforming the spatial gradient vector to a Cartesian coordinate system." Heimdal et al. and Criton et al. do not disclose these limitations.

Heimdal et al. determines a one-dimensional strain rate (col. 8, lines 42-59). The strain rate is a real or complex value for a given location (col. 8, lines 51-59; col. 9, lines 42-48). The value is a magnitude. The strain rate is scan converted (col. 9, lines 23-39 and col. 10, lines 5-10). The complex strain rate maintains phase information, not necessarily direction information. The real or complex strain rate is used to determine a color for each location, not a direction (col. 9, lines 35-38 and col. 10, lines 7-10).

Criton et al. calculate strain along a direction of tissue movement (col. 12, lines 30-40). The vectoral component of motion is used to calculate the strain rate (col. 12, lines 34-40). The result, like Heimdal et al. is a strain rate value or magnitude, not a vector. While a vector along one or two dimensions may be used to determine the strain rate, only the strain rate, not the vector is scan converted. Thus neither Heimdal et al. nor Criton et al. disclose transforming a spatial gradient vector to a Cartesian coordinate system.

Dependent claims 2-12 and 26-27 depend from claim 1, and are thus allowable for at least the same reasons. For example, claim 4 claims "generating a two dimensional image from ultrasound data ... as a function of the transformed special gradient vector". Heimdal et al. and Criton et al. do not transform a vector, and thus do not generate an image as a function of a transformed vector. Similarly, there is no suggestion to generate an image from data as a function of the vector where the vector is calculated from the scan data.

As another example, claim 5 claims "filtering ultrasound data ... as a function of the transformed spatial gradient vector". Heimdal et al. and Criton et al. do not transform a vector, and thus do not filter as a function of the transformed vector. Heimdal et al. filter the strain rate, but do not suggest the filtering of data as a function of a vector.

As yet another example, claim 9 claims "calculating two spatial derivatives in the Cartesian coordinate system as a function of multiplying at least two spatial gradient vectors in the acoustic domain by a matrix." Torp et al. is relied on for the rejection of this limitation. Torp et al. use matrix multiplication to determine strain rate along a direction of tissue movement (col. 13, lines 37-67). The data is determined relative to tissue (UVW) from data in an acoustic domain (XYZ) (col. 13, lines 40-46 and col. 13, line 65 - col. 14,

line 40). Torp et al. do not suggest conversion to a Cartesian coordinate system using matrix multiplication. According to Heimdal et al. and Criton et al., scan converters are used, not matrix multiplication.

Claim 10 is allowable for at least the same reasons discussed above for claim 9.

Independent claim 13 claims "calculating a spatial gradient vector representing a gradient in a Cartesian coordinate space from ultrasound data in an acoustic domain, the ultrasound data being free of scan conversion." Torp et al. show converting velocities in an acoustic domain to strain rates in a tissue domain (cols. 13 and 14). There is no suggestion to calculate a spatial gradient vector representing a gradient in a Cartesian coordinate space. Torp et al. calculate gradients in the acoustic space (col. 13, line 67 - col. 14, line 5) and convert the gradient, and thus do not suggest calculating a vector representing a gradient in the Cartesian coordinate space from data in acoustic domain.

Independent claim 15 claims "resampling ultrasound data in an acoustic domain to ray-lines representing a viewing angle through a volume; and determining gradient information from the resampled ultrasound data." Torp et al. estimate strain rate in any direction (col. 5, lines 57-61). The strain rate for a given sample is based on tissue velocity from a small region around the sample (col. 5, lines 57-61). Because the tissue movement direction may vary throughout an image at a given time, Torp et al. desire strain rate based on local directional information. Torp et al. do not disclose resampling to ray-lines representing a viewing direction. A person of ordinary skill would not have resampled to lines representing a viewing angle since Torp et al. desire a locational or tissue region approach.

Dependent claims 16-20 depend from independent claim 15, and are thus allowable for at least the same reasons. Torp et al. with Heimdal et al. and Criton et al. fail to disclose limitations of the dependent claims. For example, claim 16 claims "determining values along the ray-lines as a function of the resampled ultrasound data and the gradient

information; and blending along the ray-lines with the values". Torp et al. determine the values by resampling or angle correcting, and do not determine values with the resampled data and gradient information.

Independent claim 21 claims "shading ultrasound data representing locations in a three dimensional volume as a function of a viewing angle; and resampling the shaded ultrasound data to ray-lines representing the viewing angle through the three dimensional volume." Neither Sano et al. nor Cline et al. do not disclose these limitations.

Cline et al. note the use of shading (col. 1, lines 48-58), but do not disclose whether the shading is prior to resampling to a viewing direction. Also, the interpolation of Cline et al. is for surface rendering, not resampling to ray-lines representing a viewing direction.

Sano et al. account for incident light by altering data already on a projection line (col. 1, lines 60-67; col. 2, lines 20-37). The light calculations are performed as part of the volume rendering (col. 8, lines 41-60; col. 10, lines 4-11). Thus Sano et al. do not disclose shading and then resampling the shaded data.

Odell use aperture shading or channel data, not beamformed data representing a ray-line or shaded as a function of a viewing angle.

Ri et al. shade in the sense of adding color, not shading as a function of a viewing angle.

Applicants respectfully submit that the four references used together do not suggest shading data and resampling the shaded data to ray lines representing a viewing direction. Sano et al. shows the opposite, resampling and then shading.

Dependent claims 22-25 depend from independent claim 21, and are thus allowable for at least the same reasons. Further limitations of the dependent claims distinguish from the cited references. For example, the cited references do not suggest shading acoustic domain data as a function of viewing angle as claimed in claim 24.

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CONCLUSION:

Applicants respectfully submit that all of the pending claims are in condition for allowance and seeks early allowance thereof. If for any reason, the Examiner is unable to allow the application but believes that an interview would be helpful to resolve any issues, he is respectfully requested to call the undersigned at (650) 943-7350 or Craig Summerfield at (312) 321-4726.

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